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Modelling the water and energy budget in alpine environments at plot and catchment scale

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The Mazia Valley, located in the Central Alps (South Tyrol, Italy), was chosen in 2009 for long-term eco-hydrological research, with the aim to study the effects of climate change on the water balance and the consequences for the vegetation in a dry alpine region. The approach used is multidisciplinary, since it includes intensive hydrological and ecological monitoring both at plot and catchment (100 km^2) scale, remote sensing observations and simulations using the physically-based eco-hydrological model GEOtop. The model describes the energy and mass exchanges between soil, vegetation, and atmosphere, accounting for land cover, water redistribution, snow processes, glacier mass budget and the effects of complex terrain. In the study area 17 monitoring stations were installed to continuously measure standard micrometeorological variables, vegetation properties and soil moisture. The stations were distributed over the whole catchment to encompass the variability in elevation, slope aspect, soil properties, and land cover. The discharge of the catchment was measured as integrating hydrological variable. In addition, during intensive measurement campaigns, the spatial distribution of soil moisture, surface temperature and snow cover was determined by means of remote sensing images and ground surveys. The collected data set permits a multi-scale and multi-process validation of the model, in order to close the water balance and accurately estimate its components both at plot and catchment scale. In this contribution we want to show how, when dealing with complex physically-based eco-hydrological models, considering the comparison of different kind of output variables with different observations on the same time can lead to a more coherent and accurate estimation of the catchment hydrological behaviour. The model can be used as a tool to test hypotheses, which can be verified in the field. In particular, we present here the results for the 2009-2010 water year. Plot scale soil moisture and snow observations, combined with remote sensing snow and thermal images help to discriminate between uncertainties in input data (i.e. snow/rainfall partitioning) and model parameterization, in order to improve not only runoff prediction, but also the space-time evolution of soil moisture and evapotranspiration. The presented approach permits to evaluate the relative importance of the different environmental factors and shows how the use of different kind of data can improve process representation in complex hydrological models.